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GREATER NEW YORK'S WATER SUPPLY.

BY F. B. THURBER.

WHEN the New Croton Aqueduct was completed a few years ago, it was generally understood that an ample water supply, for many years, had been secured for New York; although it was known that Brooklyn was approaching the danger limit, and that with her rapidly increasing population, an additional water supply would soon be absolutely necessary. In his inaugural message, Mayor Van Wyck said:

"A most serious public necessity is presented by the problem in the solution of which the city is to be accommodated with a sufficient water supply. Especially in the Borough of Brooklyn is the adequacy of the quantity of water, available through present facilities, a matter of grave complaint.

"Early in December last, in a communication addressed to the Mayor of Brooklyn, the then Commissioner of City Works thus described the situation:

"The careful investigations prosecuted under my predecessor, and actively continued during my administration, show, and it is a matter of public record, that the available supply from the present watershed, even if developed to its utmost estimated capacity, would not be sufficient to carry us beyond the end of the present century, and that an additional water supply from new sources should be procured and be ready for use at the beginning of 1900. It has also been reported by this Department, and is a matter of public record, that the intervening time was scarcely sufficient to construct the work necessary to procure such additional supply. Lastly, it has also been repeatedly stated and published that the limit of the present supply would be shortened in proportion to the delay in carrying out the works planned for the development of the watershed or curtailment of the same, so that the city might find itself without an adequate supply long before the end of the present century. Owing to the absolute failure to provide means for the execution of the works referred to, the limit of the present supply has now been reached, and we are depending mainly on favorable weather conditions to carry us through, and are compelled to resort to risky and destructive expedients to bridge over a most critical situation.'

"Not only in the Borough of Brooklyn is the water supply a question of great anxiety, but even in the Borough of Manhattan the situation, if not

alarming, is certainly deserving of most serious consideration. The all-important interests of health and safety involved require that the sufficiency both of the watershed and the facilities for distribution should be placed beyond all dispute."

The importance not only of an increased supply of water, but also of a dual supply, so that if one is disabled the other can temporarily supply pressing wants, has long been recognized. At the instance of prominent merchants the Legislature authorized the commissioners of the Sinking Fund to contract for such a supply.* Various petitions have been submitted to the commissioners of the Sinking Fund to this end, and hearings have been had. Specimens of the petitions are as follows :

"We, the undersigned merchants and citizens doing business in the City of New York, respectfully call your attention to the alarming insufficiency of the present supply of water, and the great danger of destructive conflagrations in the business portion of the city. Each fire that occurs demonstrates the necessity of an independent supply, under sufficient pressure, to meet the requirements of the Fire Department in extinguishing fires in high buildings. In view of these facts we respectfully petition your Honorable Board to take such action as may be necessary to ascertain if an adequate supply from some new and independent source can be obtained that will be delivered to this city in the necessary quantity, and under sufficient pressure, available at all times for the protection of our property; and if such supply is obtainable, that you take the necessary steps as early as possible to secure the same, and thus further the well-being, safety and prosperity of the city."

This was signed by H. B. Claflin & Co., Dunham, Buckley & Co., J. W. Goddard & Sons, Sweetser, Pembroke & Co., Tefft, Weller & Co., Faulkner & Co., Leshner, Whitman & Co., Morrison, Herriman & Co., John F. Plummer & Co., Bliss, Fabyan & Co., Russell & Erwin Mfg. Co., Peck, Stowe & Wilcox Co., Thurber, Whyland & Co., Sargent & Co., Acker, Merrall & Condit, Huntington, Hopkins & Co., Garner & Co., Harper & Brothers, Hoyt Brothers, and The American News Company.

The following is an extract from still another petition to the Sinking Fund Commissioners by the Committee on Water Supply of the New York Board of Fire Underwriters :

"It is hardly necessary for us to remind you, gentlemen, of the urgent and pressing need of an immediate addition to the present supply of water in this city, and of the danger to which property is exposed in consequence of the limited quantity of water and inadequate pressure which the Croton aqueduct affords; these are matters familiar to you all, and have been sufficiently urged before you by merchants and underwriters."

* Chap. 512, Laws of 1883, and Chap. 292, Laws of 1884.

The desirability of a special fire service was, at the time of the agitation in 1886 and 1887, carefully considered and advocated by B. S. Church, Chief Engineer of the Aqueduct Commission, G. W. Birdsall, Chief Engineer of the Croton Aqueduct, and Julius W. Adams, Consulting Engineer of the Department of Public Works; also by A. Fteley, Engineer of the Aqueduct Board, Clemence Herschell, Civil Engineer, and F. W. Simons, Engineer of the U. S. Army, who made a statement September 15, 1887, including the following :

“The lack of pressure in the pipes in a larger part of the city is a matter distinct from that of the available amount of water on hand, and is no less to be considered, and calls for the promptest relief. At its best the extreme available pressure from the Croton Water Works is not very great (119 feet above tide at the Central Park reservoir), and it is insufficient to give a very good fire protection, and to supply several high service districts within the city limits which are supplied by pumping stations. To do away with these pumping stations, and instead to supply all the high service districts from one central source, of a proper and sufficient elevation, would result in a notable economy to the city. . . .

“Besides the value of such an additional supply for fire protection and for economical ends, there is still another point of view. . . . This point of view is the great necessity and desirability of supplying a dual system to a city of the size of New York. There can be no doubt that the danger of a water famine, with its attendant horrors and losses, would be very materially lessened if New York had two independent sources of supply, separated beyond the city limits by the Hudson River. Whether the injury to one system of water supply be due to natural causes, to military occupation or to mob rule, it is but an elementary principle of business to provide duplicate means for the avoidance of disaster.”

At one of the hearings Mr. John H. Washburn, President of the New York Board of Underwriters, submitted an exhaustive statement, eloquent in facts, among which was a table showing the daily consumption *per capita* in thirty of the principal cities of the United States, ranging from 252 gallons down to 95 gallons, *that of New York being the lowest of all.*

Nothing came from these representations; the public seemed to think that the new aqueduct would furnish a sufficient water supply and a waiting policy was adopted. Meantime, the problem in Brooklyn had been steadily growing. In December, 1896, a petition of the commercial and manufacturing interests of that city was presented to the Mayor and Board of Aldermen, urging the necessity of an additional water supply. A series of public hearings were given, at which much interesting matter was developed. At one of these Mr. George A. Stanton, representing

important insurance interests, made a statement, of which the following is a part :

"I have taken the trouble, as I have been interested in these questions, to consult an eminent hydraulic engineer. Let us talk this matter over fairly. We have continuously discussed this question of Brooklyn's water supply for years past as if Brooklyn was an immense village, instead of a city of 1,200,000 inhabitants. I have heard it stated by members of the Manufacturers' Association that in ten years, instead of needing 100,000,000 gallons of water we shall want 150,000,000 gallons *per diem*.

"This hydraulic engineer has made several estimates for me, based upon the condition that 100 pounds pressure shall be produced on the water mains of Brooklyn by the new supply. The figures are not only interesting, but very instructive at this time.

"Much has been said about Lake George as a possible source. Lake George has an elevation above tide-level of 343 feet. A tunnel from Lake George to Sandy Hill, 60,000 feet in length, would be required to go under the dividing ridge between the Lake George watershed and the valley of the Hudson River. After the water was delivered into the Hudson Valley it would flow by gravity to tide-level at New York, but would then have to be pumped again to an elevation of 300 feet. The cost of such water works, including pumping machinery, capitalized at four per cent., would be \$74,250,000, or equivalent to a net cost of \$110 per 1,000,000 gallons of water supplied daily.

"Lake Champlain has been mentioned. The elevation of Lake Champlain is 100 feet above tide-level. It would require (without pumping until tide-level was reached) a tunnel 300,000 feet in length between the lake and Troy, where all the water would have to be pumped 250 feet high in order to have it reach tide-level at New York by gravity. Then it would have to be pumped again 300 feet high. The cost of this plant, including the pumping machinery, capitalized at four per cent., would be \$105,325,000, or equivalent to \$145 per 1,000,000 gallons.

"Lake Ontario has also been brought into this question. The elevation of Lake Ontario above tide-water is 247 feet. A conduit from this lake to Albany, without pumping, would require a tunnel 930,000 feet long; and from such a conduit the water could be delivered 20 feet above tide-level at Albany. There it would have to be pumped 230 feet high in order to flow by gravity to tide-level at New York, where it would again be pumped 300 feet high. The cost of such a plant, including pumping machinery, capitalized at four per cent., would be \$132,135,000, equivalent to \$190 per 1,000,000 gallons.

"Now, the question has been brought up in the Legislature, as to another source of water supply—*viz.*, the Adirondacks. Another engineer has made calculations, independent entirely of those made by the gentleman to whom I have referred, and whose figures I have quoted. If I were to mention his name in this room to-day, you would recognize it as one of national reputation. In a conversation with him by a friend of mine, this engineer stated, within the past ten days, that, in his opinion, to build the retaining reservoirs at the altitude necessary to give the pressure at the city line in New York or Brooklyn, and to build the conduits necessary to furnish the supply from the Adirondacks, the cost would be somewhere between \$200,000,000 and \$250,000,000. As to time, three years, at least, would be required to

secure the necessary legislation and to make preliminary surveys, before putting a spade into the ground. The matter would have to be submitted to popular vote in addition to the authorization of the Legislature, which authorization would require an additional year. To build the conduits and reservoirs would require at least five years, and it would then be accomplished only by letting out the work in contracts of twenty-five miles each, so that construction on ten or more contracts could proceed simultaneously.

"Now, it strikes me that if we are going to discuss this matter intelligently, we must look at the question as to where Brooklyn stands to-day as to its resources, before being a party to such a great work as this. Has Brooklyn the means to do this or not? Has any provision been made so that the city of Brooklyn can participate in so large an expenditure of money for a water supply? As I understand it, Brooklyn is within \$500,000 of its debt limit, and, therefore, it cannot be supposed that Brooklyn will undertake this. Do you, gentlemen, suppose for one moment that the people in the western section of this State are going to see a State debt incurred for the benefit of the cities of New York and Brooklyn of \$200,000,000 or \$250,000,000? I think not. The debt of the State of New York to-day is not over \$7,000,000 or \$8,000,000.

"What, then, is the city of Brooklyn to do? It has got to do one of two things: Either it has got to rely upon itself and see itself go down, or else it must seek outside for some method or plan so that it can purchase its water. There is no other way out of the difficulty. I have studied this matter for months. I believe in municipal ownership if we can get it; but I cannot see for myself where there is any loophole out of this question but to get our water from somebody else."

The discussion continued in the press, and the Committee on Water and Drainage of the Board of Aldermen of Brooklyn was instructed to take testimony on the subject; and on December 30, 1897, made a report, of which the following are salient points:

"The importance of the subject of greatly and permanently increased water supply, and the general interest which it appears to have excited, are indicated by a few sentences of the petition of the merchants, and the letter from the Real Estate Exchange above referred to. We quote:

"We, the undersigned merchants, manufacturers, owners of property, and rent payers, desire respectfully to call your attention to the subject of Brooklyn's water supply and the falling pressure from the water pipes, and to urge upon you the great necessity for some speedy action which shall place the first and proper interest for the comfort, safety, and health of this great city beyond the dangers that have almost annually threatened us from water shortage.

"There is abundant official recognition of insufficient water supply and anxiety for the immediate future.

"There is no further supply available on Long Island.

"Chapter 942, of the Laws of 1896, provides that the Board of Supervisors of Suffolk County may "decide that certain streams and ponds within such county are necessary for the supply of pure and wholesome water to

the people residing in such county," and may "direct a certificate to that effect to be duly signed and acknowledged by the Chairman and Clerk of said Board, and cause the same to be recorded in the office of the Clerk of said County."

"The law also provides that after the recording of such certificate no person, corporation or municipality can lawfully take water from the ponds and streams mentioned therein for the purpose of supplying it to any city outside the county. The Board of Supervisors of that county have so decided and fully availed themselves of the benefits of the statutes and excluded Brooklyn from the use of waters from their territory.'

"At the second hearing Chief Engineer Milne made statements regarding the condition which, as he understood it, then confronted the City Works Department in this matter:

"Question: Is Suffolk County excluded from your rights by law?

"Mr. Milne: I am so informed; by legislative enactment.

"Question: I so understand it, that the city is not permitted to enter Suffolk County for the purpose of obtaining water. Well, have all known means of reaching the greatest supply that can be obtained from Queens County been adopted and put into execution?

"Mr. Milne: I believe they have.'

"No relief can be obtained from New York or the Greater New York.

"The possibility of securing any temporary assistance by the loan of water from the Croton supply appears to have been settled by the following official statements as to the present and prospective restrictions which are experienced by New York, contained in a letter written by Mr. Alphonse Fteley, Chief Engineer of the Aqueduct Commission of New York City, in reply to questions in writing by Chief Engineer Milne:

"When the new Croton dam, Cornell's, is built, thereby completing the storage system of the Croton River watershed, it is estimated that the capacity of the works will average 280,000,000 gallons per day in a dry year. The new Croton dam will require five years for its completion. In the meantime we have hardly storage enough to meet the present consumption, which at the present time is 225,000,000 gallons per day from the Croton watershed. It is expected that the opening of the new mains now being laid from the Central Park reservoir through the lower part of the city will cause a daily increase of 25,000,000 gallons.

"At the rate that the consumption has been increased since the opening of the new aqueduct in 1890, when the consumption was 115,000,000 gallons daily, New York will require all the water that the construction of the new Croton dam will procure at the time of its completion. New sources of supply will consequently be needed in the near future, and investigations should now be begun in that direction.

"For the reasons above given, it is clear that New York could not supply Brooklyn with any amount of water in five years from now.'

"Engineer of Water Supply de Varona stated in his report to this Committee a similar result from his own inquiries, as follows:

"I am led from the data in my possession, and from my correspondence with the Chief Engineer of the Croton Aqueduct, to infer that the city of New York cannot spare for our use any portion of their supply from their present sources.'

"A supply from new sources, to be delivered in 1900, and sufficient for a term of years thereafter, is now imperatively demanded.

"In his annual message to the Common Council, submitted January 4, 1897, Mayor Wurster said :

"I am heartily in favor of action being taken looking toward a lasting supply."

"A requisite supply is available on the mainland.

"The testimony given at our hearings, and the official reports of the City Works Department during the term of Commissioner White, indicate that a sufficient supply can be secured on the mainland, either from the Housatonic River (Ten Mile Creek), the Ramapo River, the Catskill Mountains, Lake George, the Adirondacks, or the Great Lakes. The first two of the possible sources were reported upon by Commissioner White. Each of the others is said to afford ample quantity. Hence it seems to become a question of securing water from some one of them by contracting with private corporations or individuals.

"Regarding such an effort toward obtaining a supply, but without reference to the city's financial condition, his Honor, Mayor Wurster, is reported to have spoken as follows in an interview published on February 27, 1896 :

"The Mayor was then asked if he believed it would be more advisable to buy the water supply for the city outright than to secure it by leasing of water privileges. In reply, he said :

"It is purely a matter of business. If it can be shown that the city can buy water cheaper than the cost of pumping it, then it would be profitable to buy it, for under such an agreement the seller would have to deliver the water to the city. It is a purely business matter, the same as if a man in one line of business required certain material in conducting that business. If he could buy it from a man who has the plant for manufacturing it, at a less cost than it would be for him to manufacture it himself, he would not be much of a business man if he did not avail himself of the opportunity to buy the material."

"The conclusion is, therefore, plain that the minimum yield of our watershed will be absorbed in less than three years and the maximum yield will be practically mortgaged in less time than was originally contemplated.

"Three plans for additional water supply were submitted to the Hon. A. T. White, late Commissioner of City Works, each based upon the idea of furnishing one hundred millions of gallons of water in twenty-four hours. The first comprises a watershed on Long Island east of the present shed. The second referred to the Ramapo watershed, located on the west side of the Hudson River in the State of New York ; and the third to the Ten Mile River watershed, a branch of the Housatonic, in the State of New York.

"As to the first plan : The scheme of it involves the extension of the present system to the east on the same general basis of scope and design. The cost of construction, however, is estimated to be more than either of the others. Such cost is inevitably due to the necessity of pumping, to the sums to be paid for land damages and for the extinction of existing water rights. To this must be added the great expense of the maintenance of the costly pumping systems necessitated. Quite forty per cent. of the total yield estimated would have to be obtained by driven wells. Such wells have been found to be somewhat precarious or unreliable as well as expensive undertakings. There may be no need to dwell on this feature.

"Water can be furnished to the city by gravity. It can be secured from ample storage grounds. These can be found remote from the polluting

influences inseparable from thickly populated localities, but the city would be relieved from the necessity of creating and maintaining an expensive system of pumping and carriage, and an intercepting sewerage plan of incalculable cost to protect what supply might be obtained.

"Your committee have experienced great difficulty in getting prompt and accurate information for the completion of this report, and now recognize the fact that Brooklyn must depend on Greater New York for a future water supply from other sources than Long Island."

An interview with the Chief Engineer of the New York Aqueduct Commission, Mr. Alphonse Fteley, January 3, 1898, is very significant. Space will only permit the following brief extracts :

"I regret that the bill offered in the last Legislature to empower the Aqueduct Commission to make surveys for an increased water supply for New York City did not pass, because the Croton watershed limit is nearly reached in the water consumption of New York, which now approximates 230,000,000 gallons daily or more. Moreover, an additional consumption estimated at 25,000,000 gallons daily is expected from the opening of the new 48-inch pipes in Fifth Avenue. Something should consequently be done to investigate new sources of supply.

"There has been a good deal said concerning the Adirondacks, the Great Lakes, and Lake Champlain. The watershed of Lake Champlain is small, and as to taking water from the Adirondack region, it would be a project which would consume a number of years, and the expense would be enormous.

"It is my opinion that an additional source of water supply must be procured, but others should be found which would be sufficient for a long time to come.

"Concerning the plan to utilize salt water for Fire Department purposes, I think the plan is a good one, merely upon the ground that it would furnish a duplicate system for fire purposes.

"It is true that in 1888 I made a joint report in favor of the plan proposed for delivering to New York from New Jersey an independent supply of 50,000,000 gallons per day. I did so for the reason that I am a believer in the principle of having a dual system in view of possible contingencies which, in a city placed like New York, might result in very grave danger. I consider it in the light of an insurance matter.

"If 50,000,000 gallons a day could be delivered into the Croton Aqueduct from the Fort Montgomery water shed, as you say, it would be an excellent thing to rely upon. I do not think, however, that this could be done in two years.

"I have not made a special study of the Esopus water shed, but I understand in a general way that its available watershed is large, and that it could be connected with other drainage areas.

"Brooklyn is even more pressed for water than we are and I am told that something must be done there at once.

"It is a very serious condition of things, and it should have been taken in hand several years ago. I recommended to the Aqueduct Commissioners in 1893 the importance of making surveys for additional watershed. Last

year the bill asking for authority to survey for additional water supply was introduced, but nothing was done."

The importance of a sufficient gravity pressure cannot be better expressed than by the following statement by Mr. Francis C. Moore, President of the Continental Insurance Co., in a pamphlet entitled "Water Works and Pipe Distribution."

"The best system of water-works for fire extinguishing purposes is a gravity system, with the reservoir at a sufficient elevation to ensure, with full draught, an effective head or pressure *at the hydrants* of eighty pounds to the square inch or not less than forty pounds to the square inch at the base of the nozzle with 250 feet of hose.

"The force of gravity acting with an ample reservoir differs from pump pressure for forcing water through pipes, in the important respect that it is always ready for instant use without notification by means of electric wires, telephones, etc., and it is not liable to break down or get out of order like pumps or other direct pressure appliances. It, moreover, exerts, at all times, a steady pressure on the pipe system, reducing the liability of breakage to a minimum. A gravity system has a decided advantage over a direct pressure pumping system in that (if pipes are of proper sizes) the full volume of flow is instantly available without waiting to fire up extra steam boilers."

In the same paper Mr. Moore illustrates how the water front supply of water may be utilized for fire purposes by fire boats pumping through a proper network of pipe lines within certain areas. While the quantity of water used for fire purposes is small compared with that needed for potable and manufacturing purposes, it is none the less important that all methods to meet the wants of all localities in the municipality should be availed of. An adequate supply of water for all purposes is a prime requisite, and that the first city of the United States in population, commerce and manufactures should be the lowest of thirty of the principal cities in an adequate water supply, as shown by Mr. John H. Washburn, is an anomaly.

To sum up, there are certain main points which are apparent :

1. The need for an additional water supply is pressing in the Borough of Brooklyn, and soon will be in the Borough of Manhattan.

2. The supply should have ample watershed, free from pollution, and be supplied by gravity, with sufficient head to supply our highest buildings. As expressed by a prominent merchant: "We now have a three-story supply for a ten-story town."

3. It should be within the State of New York, and duplicate existing sources, so that if one source fails, it would be supplemented by the other.

4. In view of the constitutional limit of taxation, if private capital will furnish an adequate supply at no higher rate than the cost under municipal ownership, it should be taken advantage of.

5. In the Catskill Mountains and their southern foothills, we have a clear, cold, trout-stream supply, from a sparsely settled hardwood forest district, known to every fisherman, with ample volume and an elevation to afford an adequate head to reach our highest buildings, at a distance and at a cost much less than those of the Adirondacks or the Great Lakes, or any other available watershed.

F. B. THURBER.